11-15-00

01/2000 FORM 1

Sheet 1 of 4

A

TRANSMITTAL FORM FOR FILING PATENT APPLICATION

jjc93 U.S. PTO 11/14/00

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Docket No.: SYNER-174XX

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jc816 U.S. PTO 09/712610 11/14/00

Express Mail No: EL418427740US

BOX PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Date: November 14, 2000

First Named Inventor or Application Identifier: Carl John Lindeborg et al.

Sir:

Transmitted herewith under 37 CFR § 1.53 for filing is the patent application of:

Inventor: Carl John Lindeborg, Mark David Moreau, Keith Louis Petry, John Ernest Ziegler

Entitled: INTELLIGENT NETWORK TOPOLOGY AND CONFIGURATION VERIFICATION USING A METHOD OF LOOP DETECTION

[ ] This is a request for filing a [ ] **continuation** [ ] **divisional** [ ] **continuation in-part** application under §1.53(b) of prior Application No._____, filed _____ entitled:

Enclosed are:

[X] 24 pages of written description, claims and Abstract, inclusive

[X] 2 sheets of [ ] informal [X] formal drawings of Figs. 1-2 (one set)

[X] Oath or Declaration
- [X] Newly executed (original or copy)
- [ ] Copy from prior application (37 CFR 1.63(d)) (for continuation/divisional). The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
- [ ] Unsigned (To be filed later)

[X] Cover sheet and Assignment of the invention to: 3Com Corporation

[ ] Certified copy of a _____ application (if foreign priority is claimed) with letter claiming priority under Rule 55.

[ ] Information Disclosure Statement with __ citations

[ ] Preliminary amendment is enclosed.

[X] Return receipt postcard

[ ] Small entity status is entitled to be, and hereby is, asserted for this application.

Attorney Docket No.: SYNER-174XX

TRANSMITTAL FORM FOR FILING PATENT APPLICATION (CONTINUED)

[ ] Other: _____

[ ] Priority is claimed under 35 USC § 120 as indicated on the attached sheet 4.

[ ] Priority is claimed under 35 USC §119(a)-(d) as indicated on the attached sheet 4.

[ ] Priority is claimed under 35 USC §119 (e) as indicated on the attached sheet 4.

[X] David A. Dagg is hereby appointed Associate Attorney by:
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[ ] Power of Attorney in the originally-filed application has been granted to one or more of the registered attorneys listed below. The attorneys listed below not previously granted power in the originally-filed application, as well as _____, are hereby given associate power:
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[ ] Cancel in this application original claims _____of the prior application before calculating the filing fee.

[ ] Add in this application claims _____ per amendment before calculating fee.

CLAIMS FILED:	MINUS BASE:	EXTRA CLAIMS:	RATE:	BASIC FEE:
				$710.00
Independent	3 - 3	= 0	x $80.00 =	$0.00
Total	27 - 20	= 7	x $18.00 =	$126.00
[ ] Multiple Dependent Claims (1st presentation)			+ $270.00 =	
			SUBTOTAL FILING FEE	$836.00
Small Entity filing, divide by 2. (Small Entity status must be asserted.)				$0.00
			TOTAL FILING FEE	$836.00

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TRANSMITTAL FOR FILING PATENT APPLICATION (CONTINUED)

[X] The filing fee has been calculated above; a check in the amount of $836.00 is enclosed.

[ ] The filing fee will be submitted at a later date.

[X] In the event a Petition for Extension of Time under 37 CFR §1.17 is required by this paper and not otherwise provided, such Petition is hereby made and authorization is provided herewith to charge Deposit Account No. 23-0804 for the cost of such extension.

[X] The Commissioner is hereby authorized to charge payment of any additional filing fees under 37 CFR §1.16 associated with this communication or credit any overpayment to Deposit Account No. 23-0804.

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Attorney Docket No.: SYNER-174XX

TRANSMITTAL FOR FILING PATENT APPLICATION (CONTINUED)

[ ] Priority is claimed under 35 USC § 120 of prior Application(s) No. _____, filed_____, entitled:

[ ] The above-identified application(s) is/are assigned of record to:

[ ] Priority is claimed under 35 USC § 119 (a)-(d) of the following application(s).

(Application Number)	(Country)	(Filing Date)
(Application Number)	(Country)	(Filing Date)
(Application Number)	(Country)	(Filing Date)

[ ] The above-identified application(s) is/are assigned of record to:

[ ] Priority is claimed under 35 USC § 119 (e) of the following provisional application(s).

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

[ ] The above-identified provisional application(s) is/are assigned of record to:

SUBMIT IN TRIPLICATE

229682

TITLE OF THE INVENTION

Intelligent Network Topology and Configuration Verification Using a Method of Loop Detection

CROSS REFERENCE TO RELATED APPLICATIONS

N/A

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

N/A

BACKGROUND OF THE INVENTION

The present invention relates generally to configuring the topology of a communications network, and more specifically to a system and method for detecting and eliminating network loops connected to a bridge device installed in a networking hub.

As it is generally known, in a local area network (LAN) using a protocol such as Ethernet or Token Ring, devices referred to as "nodes" compete for the ability to use a shared communications path to exchange messages referred to as "data units" or "frames." However, if too many nodes consistently attempt to transmit simultaneously, the overall performance of the network may potentially be affected, even to the point of bringing communications over the network to a near halt. To make this possibility less likely, large LANs are often divided into two or more LAN segments

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connected by one or more networking devices referred to as "bridges." In such a configuration, each data unit is received by any bridge or bridges connected to the LAN segment on which the data unit originated. Each bridge then determines which segment or segments the received data unit should be forwarded to, and only forwards the data unit to that segment or segments. In this way, data units transmitted between nodes within a single segment are isolated from other segments, thus reducing traffic on those other segments.

A bridge determines which LAN segments to forward a received data unit onto based on destination address information within the data unit and a data structure reflecting the locations of nodes within the various interconnected LAN segments, referred to as the forwarding table or forwarding tables of the bridge. Each bridge learns where specific nodes are located by examining the MAC source addresses of data units it receives, and by forming associations between those MAC source addresses and the segments on which the data units containing them were received. In the case where a data unit is received having a destination address for which no destination segment is known, a bridge typically broadcasts that data unit onto all segments to which it is connected, to ensure that the data unit is received at its intended destination node. This approach is generally referred to as "transparent bridging", which is performed by a "learning bridge." Transparent bridging is advantageous in that it does not require setup of the forwarding tables by a network administrator.

A known problem relating to the use of bridge technology is the need to avoid what are referred to as "broadcast storms." Broadcast storms may occur when bridges

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are connected in a physical loop, which results in a logical loop sometimes referred to as a "bridge loop." A bridge loop occurs when data units can travel from a first LAN segment to a second LAN segment through more than one path. In order to eliminate bridge loops, existing bridge devices typically employ a technique referred to as the spanning tree algorithm. The spanning tree algorithm is implemented by bridges interchanging special messages known as Bridge Protocol Data Units ("BPDUs"). The specific format of BPDUs is described in IEEE 802.1. The spanning tree algorithm calls for various specific types of BPDUs to be sent by bridges to a special multicast address that is received by all bridges.

The spanning tree algorithm includes steps to (1) elect a single bridge from the connected bridges to be the "root" bridge, (2) calculate a best path distance to the "root" bridge from each other bridge, (3) identify a "designated bridge" for each LAN segment that will be used for forwarding packets towards the root bridge, (4) choose a port on each bridge that gives the best path towards the root, and (5) select ports to be included within the spanning tree. Using the bridge elected as a root bridge for reference, the spanning tree algorithm operates to switch one of any two bridges forming a physical loop in the network into a standby mode, so that only one side of a potential bridge loop passes traffic. By listening to configuration update BPDUs, a bridge in the standby mode can switch automatically from standby mode into forwarding mode in the event that the other bridge forming the physical loop fails. The spanning tree protocol thus ensures that physical loops in the network topology do not result in logical looping of network traffic.

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While the spanning tree algorithm has proven generally effective in eliminating bridge loops, implementing the spanning tree algorithm on relatively low cost bridging devices may be prohibitively costly. For example, hardware logic necessary to perform the spanning tree algorithm typically includes a spanning tree state register for each port in a bridge. The value stored in such a state register maintains a current spanning tree state for the associated port. In a bridge device supporting the spanning tree algorithm, a spanning tree state register is necessary for each port in the device, since the value of the register effects forwarding decisions made by the bridge. Accordingly, in a bridge device designed for relatively low cost applications, but containing a significant number of ports, hardware circuitry to provide a spanning tree state register for each port may add undesirable costs to the overall design. Additionally, it may be desirable in some circumstances to limit the network topologies which may be connected to a given port or ports of a relatively low cost bridging device. For example, in the case where a bridging device is designed for relatively small network configurations, it may include a relatively small forwarding table. It would be undesirable for large, complex networks, having large numbers of nodes, to be attached to a port of such a device. Accordingly, it may be desirable to have a system which further operates to prevent the attachment of large, complex networks to one or more ports of a relatively low cost bridging device.

For the reasons stated above, it would be desirable to have a system for avoiding bridge loops and the potential broadcast storms which may result from them, but which does not require the relatively costly implementation of the

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spanning tree algorithm within a relatively low cost bridge device. The system should further be applicable to bridge devices wishing to limit the types of topologies which are connected to one or more of their external ports.

BRIEF SUMMARY OF THE INVENTION

In accordance with disclosed invention, a system and method are disclosed for detecting and preventing bridge loops in a relatively low cost bridge type device designed for installation within a network hub. The network hub in which the bridge type input/output module is to be installed further includes a switching fabric, which may be integral to the network hub, or removably installed within the network hub. The switching fabric in the network hub is operable to forward data units among a plurality of input/output modules installed in the network hub, including a bridge type input/output module. The switching fabric utilizes an intra-hub communication path to perform forwarding of the data units among the input/output modules installed in the network hub. A spanning tree protocol controller operates on behalf of the switching fabric to forward bridge protocol data units on the intra-hub communication path. The spanning tree protocol controller may be implemented using hardware and/or software components appropriate for a particular embodiment of the system. Accordingly, the spanning tree algorithm functions performed by the spanning tree protocol controller may be performed by some combination of program code executing on an embedded microprocessor subsystem, or hardware circuits such as one or more Application Specific Integrated Circuits (ASICs) within the spanning tree algorithm controller.

One or more of the disclosed bridge type input/output modules may be installed within the network hub. Each bridge type input/output module includes hardware and/or software implemented logic which operates to monitor the intra-hub communication path of the network hub to detect any bridge protocol data units transmitted by the switching fabric. When an initial bridge protocol data unit is detected on the intra-hub communications path by one of the bridge type input/output modules, the bridge type input/output module stores a MAC source address of the data unit, and forwards the data unit onto its external communication ports, which are coupled to respective network segments. The bridge type input/output module then monitors its external communication ports to detect a data unit having a destination address matching the bridge multicast address used to transmit bridge protocol data units.

When a data unit having a destination address matching the bridge multicast address is detected, the bridge type input/output module compares a MAC (Media Access Control) source address of that data unit to the previously stored MAC source address from the bridge protocol data unit detected on the intra-hub communication path. In the event that the MAC source address of the data unit detected on the external communication port matches the previously stored MAC source address, the bridge type input/output module disables operation of the respective one of its external communication ports at which the data unit was received.

In one example of how the disclosed system can be extended, the bridge type input/output device further operates to prevent relatively complex network topologies from being connected to one or more of its external communications ports by monitoring those external

communications ports for routing protocol messages. In such an extended system, in the event that a routing protocol message is detected on one of those external communications ports, the bridge type input/output module disables the port. By disabling a port which receives a routing protocol message, this example of an extension to the disclosed system prevents network topologies which include routers, and which therefore are likely to be relatively large and contain many nodes, from being connected to its external ports.

In this way there is provided a system and method for detecting and eliminating bridge loops which are appropriate for use in relatively low cost bridge type input/output modules. The disclosed system does not require the relatively costly implementation of spanning tree algorithm capability within the low cost bridge device. The system is further applicable to bridge devices wishing to limit the types of topologies which are connected to one or more of their external communication ports. The disclosed system may therefore be advantageously employed in bridges which have relatively limited forwarding table resources, in order to reduce the likelihood that very complex networks having large numbers of nodes will be connected to any of the external communications port of the bridge. Additionally, because the disclosed system does not require implementation of the spanning tree algorithm within the bridge, significant savings in terms of hardware and/or software complexity and functionality may be obtained through its use.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The invention will be more fully understood by reference to the following detailed description of the invention in conjunction with the drawings, of which:

Fig. 1 is a logical block diagram showing a number of bridge type input/output modules within a network hub; and

Fig. 2 is a flow chart illustrating steps performed by an illustrative embodiment of the disclosed system.

DETAILED DESCRIPTION OF THE INVENTION

As depicted in Fig. 1, in an illustrative embodiment of the disclosed system, a network hub 10 includes a switching fabric 14, a number of bridge type I/O modules, shown as bridge A 16, bridge B 18 and bridge C 19, and point to point connections 12, 13 and 15 interconnecting the bridge type I/O modules to the switching fabric 14. The point to point connections 12, 13 and 15 each terminate at one of backplane ports 21, 25 and 27 within a respective one of the bridge type I/O modules 16, 18 and 19. In this way, the point to point connections 12, 13 and 15 form a star wired backplane. The star wired backplane illustrated by point to point connections 12, 13 and 15 in Fig. 1 is referred to herein as the "backplane".

Each of the bridge type I/O modules in the network hub 10 of Fig. 1 includes a number of external communication ports, shown as external communication ports 17 in bridge A 16. Each of the external communication ports of the bridges shown in Fig. 1 may be coupled to an end station or respective local area network (LAN) segment. Respective external communication ports of bridge A 16 are shown, for

purposes of illustration, coupled to a personal computer 20, and two local area networks (LAN 1 22 and LAN 2 24).

The external communication ports of the bridges shown in Fig. 1 may be implemented to support various communication media and protocols. For example, one or more of the external communication ports 17 in bridge A may support the Ethernet protocol. Further, one or more of the external communication ports 17 in bridge A 16 may support the Token Ring protocol. In general, the external communication ports of the bridges shown in Fig. 1 may be implemented to support any physical media and associated communications protocol for which bridging functionality may be provided.

The bridges within the network hub 10 function, for example, as what are generally referred to as "learning" bridges. Accordingly, the bridges in the network hub 10 operate to forward data units they receive, in cooperation with the switching fabric 14, onto selected ones of their external communication ports, as well as to other bridges within the network hub 10. Consistent with existing bridge protocols, forwarding by the bridges shown in Fig. 1 is performed using the Media Access Control (MAC) layer of addressing information in each data unit. Each of the bridges shown in Fig. 1 employs a forwarding table describing the location of nodes on the network segments to which the bridge is connected. The network topology reflected by such forwarding tables is developed through examination by the bridges of MAC source address information within received data units on their external communication ports.

The switching fabric 14 operates to forward data units among the bridges within the network hub 10. The switching

fabric 14 further includes spanning tree algorithm functionality. In this regard, the spanning tree functionality of the switching fabric 14 operates in part to transmit bridge protocol data units (BPDUs) across the backplane, in order for the BPDUs to be transmitted out of the external communication ports of the bridges installed within the network hub 10. For purposes of illustration, the BPDUs generated by the switching fabric 14 follow the format defined in the IEEE 802.1d MAC Bridge Management protocol standard. Accordingly, the BPDUs generated by the switching fabric 14 include a MAC destination address equal to the Bridge Group Address defined for use in BPDUs in connection with IEEE 802.1d. This Bridge Group Address is a multicast address that is recognized by all IEEE 802.1 bridge devices. The switching fabric 14 may further include a network management entity, which is responsible for collecting and reporting status and maintenance information related to the network hub 10.

The switching fabric and bridges of Fig. 1 may be implemented using hardware and/or software based control logic. For example, each of the switching fabric and the bridges of Fig. 1 may include a high speed path for data unit forwarding, implemented primarily in hardware, that is designed to maintain a relatively high data unit throughput. Additionally, the switching fabric and the bridges of Fig. 1 may each include a lower speed data unit processing path, for example implemented using software or microcode executing on a microprocessor based subsystem, for handling network management and other relatively low throughput functions.

The backplane which serves as an intra-hub communications path in the illustrative embodiment of Fig. 1

may be implemented using any appropriate backplane interconnection technology which permits digitized data to be communicated between the various bridge input/output modules and the switching fabric 14. In this regard, each of the bridges and the switching fabric in the network hub 10 includes interface logic, associated with the respective one of the backplane ports 21, 25 and 27, which is operable to receive and transmit information using the backplane, such as the backplane consisting of point to point connections 12, 13 and 15 shown in Fig. 1.

Fig. 2 illustrates steps performed in connection with an embodiment of the disclosed system. A bridge input/output module, such as the bridge input/output module 16 of Fig. 1, monitors a backplane within a network hub, such as the star wired backplane shown in Fig. 1, for one or more bridge protocol data units transmitted from the switching fabric 14 within the network hub 10, as shown in Fig. 1. For example, detection of bridge protocol data units may be performed at each respective one of the backplane ports 21, 15 and 27 (Fig. 1) by comparing the MAC layer destination address of a data unit with a predetermined destination address, such as the Bridge Group Address associated with IEEE 802.1. When a data unit is detected on the backplane having a MAC destination address equal to such a predetermined destination address, the bridge input/output module determines that the data unit is a bridge protocol data unit, as shown in step 42.

Next, at step 44, the backplane port of the bridge input/output module stores the MAC source address of the bridge protocol data unit detected at step 42. In the case where the switching fabric of the network hub is the entity within the network hub that is transmitting bridge protocol

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data units over the backplane, the stored MAC source address is the MAC address of the switching fabric within the network hub. Alternatively, in the case where the spanning tree algorithm is disabled within the switching fabric, the switching fabric simply passes bridge protocol data units generated from another source onto the backplane. In either case, the stored MAC source address is copied by the respective one of the backplane ports from one or more bridge protocol data units transmitted over the backplane.

After the bridge input/output module stores the MAC source address at step 42, the bridge input/output module forwards the detected bridge protocol data unit through its external communication ports to the network segments to which it is connected at step 46.

The bridge input/output module monitors its external communication ports, as shown by step 48 of Fig. 2, to detect any bridge protocol data units received at those external communication ports. When the bridge input/output module detects a bridge protocol data unit at one of its external communication ports during step 50, it extracts the source MAC address of that detected bridge protocol data unit, and compares the extracted source MAC address with MAC address of the bridge protocol data unit detected at step 42 on the backplane of the network hub. If the extracted MAC source address is determined to match the MAC address of the bridge protocol data unit detected on the backplane, then the bridge input/output module has detected an apparent loop in the network topology connected to the external communications port at which the bridge protocol data unit was detected at step 50. Accordingly, during step 54, the bridge input/output device disables operation of the external communications port at which the bridge protocol

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data unit was detected at step 50. In this way, the bridge input/output module breaks the loop that it has detected in the network topology connected to that external communications port. Additionally, the bridge input/output module discards the bridge protocol data unit detected at step 50 in the case where the MAC source address of the bridge input/output module detected at step 50 matches the MAC address of the bridge protocol data unit detected on the backplane, such that it is not forwarded over any of the external communication ports of the bridge input/output module or the backplane of the network hub.

The disabling performed at step 54 may be performed in a variety of specific ways. Any type of disabling mechanism may be used that is effective in breaking the detected bridge loop. For example, the bridge input output module may operate to turn off or shut down the communications port such that no data units may be received or transmitted with regard to that port. A communications port that has been shut down may subsequently be re-enabled through an appropriate network management system.

At step 56 the bridge input/output module notifies a management entity regarding the disabling of the communications port at step 54. For example, the bridge input/output module passes a Simple Network Management Protocol (SNMP) message to a management entity associated with the network hub. Such a management entity may, for example, consist of software executing on the switch fabric within the network hub. The notification may be passed through any appropriate communications mechanism, for example by way of the backplane within the network hub.

In order to maintain a correct value of the source MAC address stored at step 44, the bridge input/output module

may, in an illustrative embodiment, clear the stored value periodically. After the stored value is cleared, the bridge input/output module then operates to detect a subsequent bridge protocol data unit transmitted over the backplane, and to store the MAC source address of that data unit.

The present system may be extended to further limit the types of network topologies which may be connected to the external communication ports of the bridge input/output module. For example, the disclosed system may be extended such that one or more of the external communication ports of the bridge input/output module are configured to monitor data units it receives for router protocol data units. Illustrative routing protocols include the RIP (Routing Information Protocol) layer 4 protocol, which uses the well known UDP (User Datagram Protocol) port 520, and OSPF (Open Shortest Path First) protocol, which uses an IP protocol ID of 89. In the event a router protocol data unit is detected at one of the external communication ports of the bridge input/output module, the bridge input/output module operates to disable that communication port, and to notify an associated management entity that the communication port has been disabled. This feature effectively prevents a router device from being connected to a network segment which is coupled to one of the external communication ports of the bridge input/output module. Since connection of a router to a network segment is typically an indication of a larger, more complex network topology for that network segment, preventing connection of a router effectively limits the complexity of the network segment. Since a less complex network segment will generally involve fewer nodes, the number of nodes which must be supported by the bridge input/output module for the associated external

communication port is thereby effectively reduced in many cases.

Those skilled in the art should readily appreciate that the programs defining the functions of the bridge input/output module and switching fabric of the disclosed network hub can be implemented in and delivered to a specific embodiment of the disclosed system in many forms; including, but not limited to: (a) information permanently stored on non-writable storage media (e.g. read only memory devices within a computer such as ROM or CD-ROM disks readable by a computer I/O attachment); (b) information alterably stored on writable storage media (e.g. floppy disks and hard drives); or (c) information conveyed to a computer through communication media for example using baseband signaling or broadband signaling techniques, including carrier wave signaling techniques, such as over computer or telephone networks via a modem. In addition, while the functionality of the bridge input/out modules and/or switching fabric may be embodied in computer software, these functions may alternatively be embodied in part or in whole using hardware components such as Application Specific Integrated Circuits or other hardware, or some combination of hardware components and software.

While the invention is described through the above exemplary embodiments, it will be understood by those of ordinary skill in the art that modification to and variation of the illustrated embodiments may be made without departing from the inventive concepts herein disclosed. Accordingly, the invention should not be viewed as limited except by the scope and spirit of the appended claims.

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CLAIMS

What is claimed is:

1. A method for preventing bridge loops in a network topology, comprising:

monitoring an intra-hub communication path of a network hub to detect a first data unit on said intra-hub communication path having a destination address matching a first predetermined address;

storing a source MAC address of said detected first data unit;

forwarding said detected first data unit onto a plurality of external communication ports;

monitoring said plurality of external communication ports to detect a second data unit having a destination address matching said first predetermined address received at a respective one of said plurality of external communication ports;

comparing a source MAC address of said second detected data unit to said stored source MAC address; and

in the event that said source MAC address of said second detected data unit matches said stored source MAC address, disabling operation of said respective one of said plurality of external communication ports at which said second detected unit was received.

2. The method of claim 1, wherein said predetermined destination address is a media access control layer bridge multicast address.

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3. The method of claim 1, further comprising discarding said detected second data unit without any forwarding of said detected second data unit over any of said plurality of external communication ports.

4. The method of claim 1, further comprising sending a message to a network management entity indicating that said one of said plurality of external communication ports has been disabled.

5. The method of claim 4, wherein said sending of said message comprises sending said message to a network management entity within said network hub.

6. The method of claim 1, wherein said detected first data unit and said detected second data unit are bridge protocol data units.

7. The method of claim 1, further comprising periodically clearing said stored copy of said source MAC address of said detected first data unit.

8. The method of claim 1, further comprising:

monitoring said plurality of external communication ports to detect a data unit of a predetermined type; and

in the event that a data unit is detected of said predetermined type, disabling a respective one of said plurality of external communication ports at which said detected data unit of said predetermined type was received.

9. The method of claim 8, wherein said step of monitoring said plurality of external communication ports to detect a

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data unit of said predetermined type comprises monitoring said plurality of external communication ports to detect a router protocol data unit.

10. Apparatus for eliminating loops in a network comprising:

a bridge type input/output module having a plurality of external communication ports and an intra-hub interface for communicably coupling said module with a switching fabric within a network hub, said input/output module including a controller operable to:

monitor said intra-hub interface to detect a first data unit having a destination address matching a first predetermined address;

store a source MAC address of said detected first data unit;

forward said detected first data unit onto said plurality of external communication ports;

monitor said plurality of external communication ports to detect a second data unit received at a respective one of said plurality of external communication ports and having a destination address matching said first predetermined address;

compare a source MAC address of said second detected data unit to said stored source MAC address; and

in the event that said source MAC address of said second detected data unit matches said stored source MAC address, disable operation of said respective one of said plurality of external communication ports at which said second detected unit was received.

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11. The apparatus of claim 10, wherein said predetermined destination address is a media access control layer bridge multicast address.

12. The apparatus of claim 10, wherein said bridge type input/output module is further operable to discard said detected second data unit without any forwarding of said detected second data unit over any of said plurality of external communication ports.

13. The apparatus of claim 10, wherein said bridge type input/output module is further operable to send a message to a network management entity, said message indicating that said one of said plurality of external communication ports has been disabled.

14. The apparatus of claim 13, wherein said bridge type input/output module is further operable to send said message by sending said message to a network management entity within said network hub.

15. The apparatus of claim 10, wherein said detected first data unit and said detected second data unit are bridge protocol data units.

16. The apparatus of claim 10, wherein said bridge type input/output module is further operable to periodically clear said stored copy of said source MAC address of said detected first data unit.

17. The apparatus of claim 10, wherein said bridge type input/output module is further operable to:

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monitor said plurality of external communication ports to detect a data unit of a predetermined type; and

in the event that a data unit is detected of said predetermined type, disable a respective one of said plurality of external communication ports at which said detected data unit of said predetermined type was received.

18. The apparatus of claim 17, wherein said bridge type input/output module is further operable to monitor said plurality of external communication ports to detect a data unit of said predetermined type by monitoring said plurality of external communication ports to detect a router protocol data unit.

19. A system for preventing bridge loops in a network topology, comprising:

a switching fabric installed in a network hub, said switching fabric operable to forward data units among a plurality of input/output modules also installed in said network hub;

a spanning tree protocol controller installed within said switching fabric, said spanning tree protocol controller operable to forward bridge protocol data units on an intra-hub communication path;

at least one bridge type input/output module installed in said network hub, said bridge type input/output module operable to

monitor said intra-hub communication path of said network hub to detect a first one of said bridge protocol data units transmitted by said switching fabric,

store a source MAC address of said detected first data unit,

forward said detected first data unit onto a plurality of external communication ports of said bridge type input/output module,

monitor said plurality of external communication ports to detect a second data unit having a destination address matching said first predetermined address received at a respective one of said plurality of external communication ports,

compare a source MAC address of said second detected data unit to said stored source MAC address, and

in the event that said source MAC address of said second detected data unit matches said stored source MAC address, disabling operation of said respective one of said plurality of external communication ports at which said second detected unit was received.

20. The system of claim 19, wherein said predetermined destination address is a media access control layer bridge multicast address.

21. The system of claim 19, wherein said at least one bridge type input/output module installed in said network hub is further operable to discard said detected second data unit without any forwarding of said detected second data unit over any of said plurality of external communication ports.

22. The system of claim 19, wherein said at least one bridge type input/output module installed in said network hub is further operable to send a message to a network management

entity indicating that said one of said plurality of external communication ports has been disabled.

23. The system of claim 22, wherein said at least one bridge type input/output module installed in said network hub is operable to send said message by sending said message to a network management entity within said network hub.

24. The system of claim 19, wherein said detected first data unit and said detected second data unit are bridge protocol data units.

25. The system of claim 19, wherein said at least one bridge type input/output module installed in said network hub is further operable to periodically clear said stored copy of said source MAC address of said detected first data unit.

26. The system of claim 19, wherein said at least one bridge type input/output module installed in said network hub is further operable to:

monitor said plurality of external communication ports to detect a data unit of a predetermined type; and

in the event that a data unit is detected of said predetermined type, disable a respective one of said plurality of external communication ports at which said detected data unit of said predetermined type was received.

27. The system of claim 26, wherein said at least one bridge type input/output module installed in said network hub is operable to monitor said plurality of external communication ports to detect a data unit of said predetermined type

comprises by monitoring said plurality of external communication ports to detect a router protocol data unit.

ABSTRACT OF THE DISCLOSURE

A system and method are disclosed for detecting and preventing bridge loops in a relatively low cost bridge module designed for installation in a network hub. The bridge operates to monitor an intra-hub communication path of the network hub to detect bridge protocol data units transmitted by a switching fabric within the network hub. The bridge module stores a MAC source address of a bridge protocol data unit detected on the intra-hub communications path, and forwards the bridge protocol data unit through its external communication ports to respective network segments. The bridge module monitors its external communication ports for any data unit having a destination address matching a bridge multicast address. When a data unit having a destination address matching the bridge multicast address is detected, the bridge module compares the MAC source address of that data unit to the previously stored MAC source address from the bridge protocol data unit detected on the intra-hub communication path. In the event that the MAC source address of the data unit detected on the external communication port matches the previously stored MAC source address, the bridge module disables operation of the respective one of its external communication ports at which the data unit was received. In one embodiment of the disclosed system, the bridge module further monitors its external communications ports for routing protocol messages. In the event that a routing protocol message is detected on one of those external communications ports, the bridge module disables that port.

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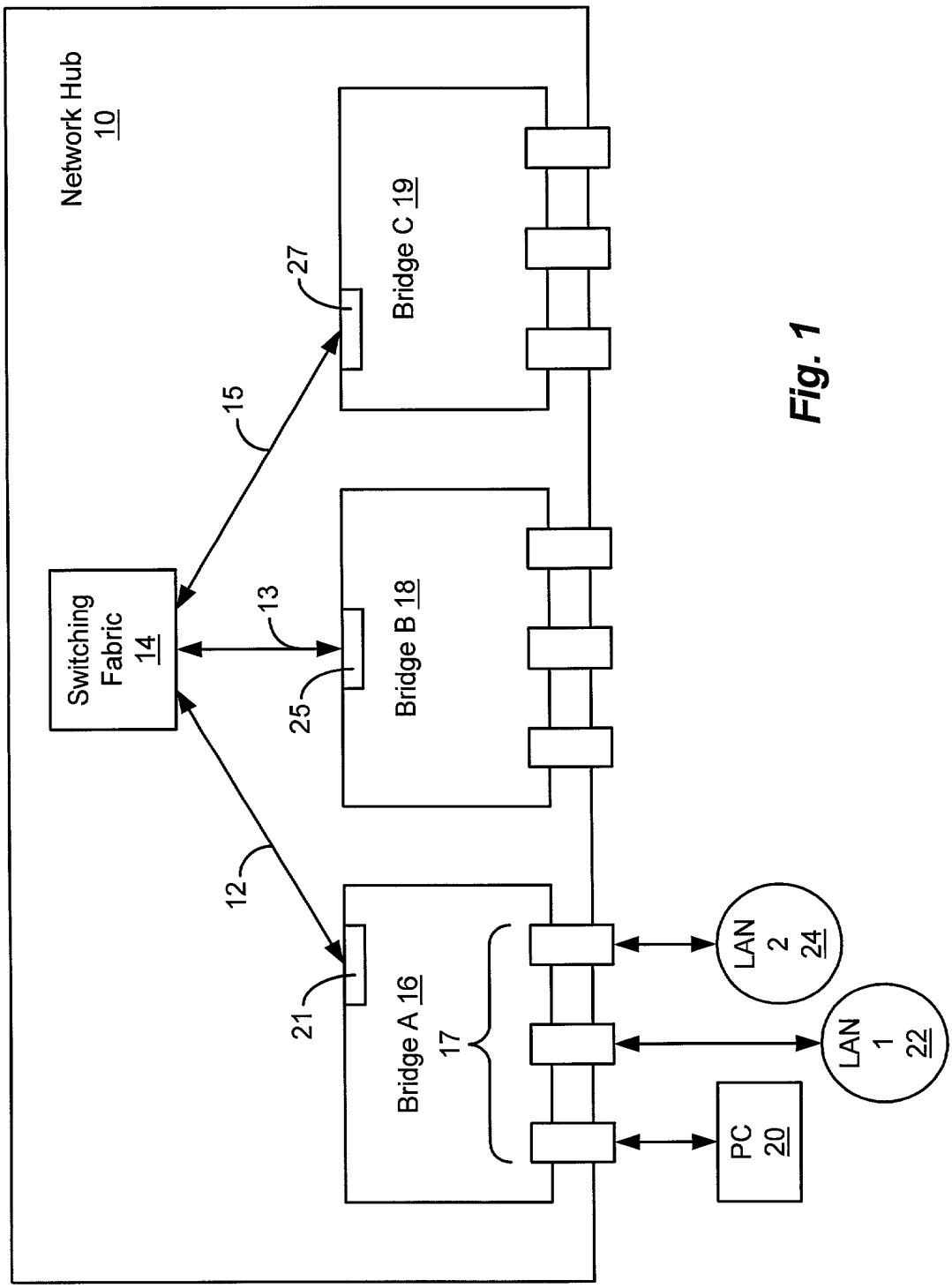
Network Hub
10
Switching Fabric
14
Bridge A 16
Bridge B 18
Bridge C 19
12
13
15
17
21
25
27
LAN 2
24
LAN 1
22
PC
20

Fig. 1

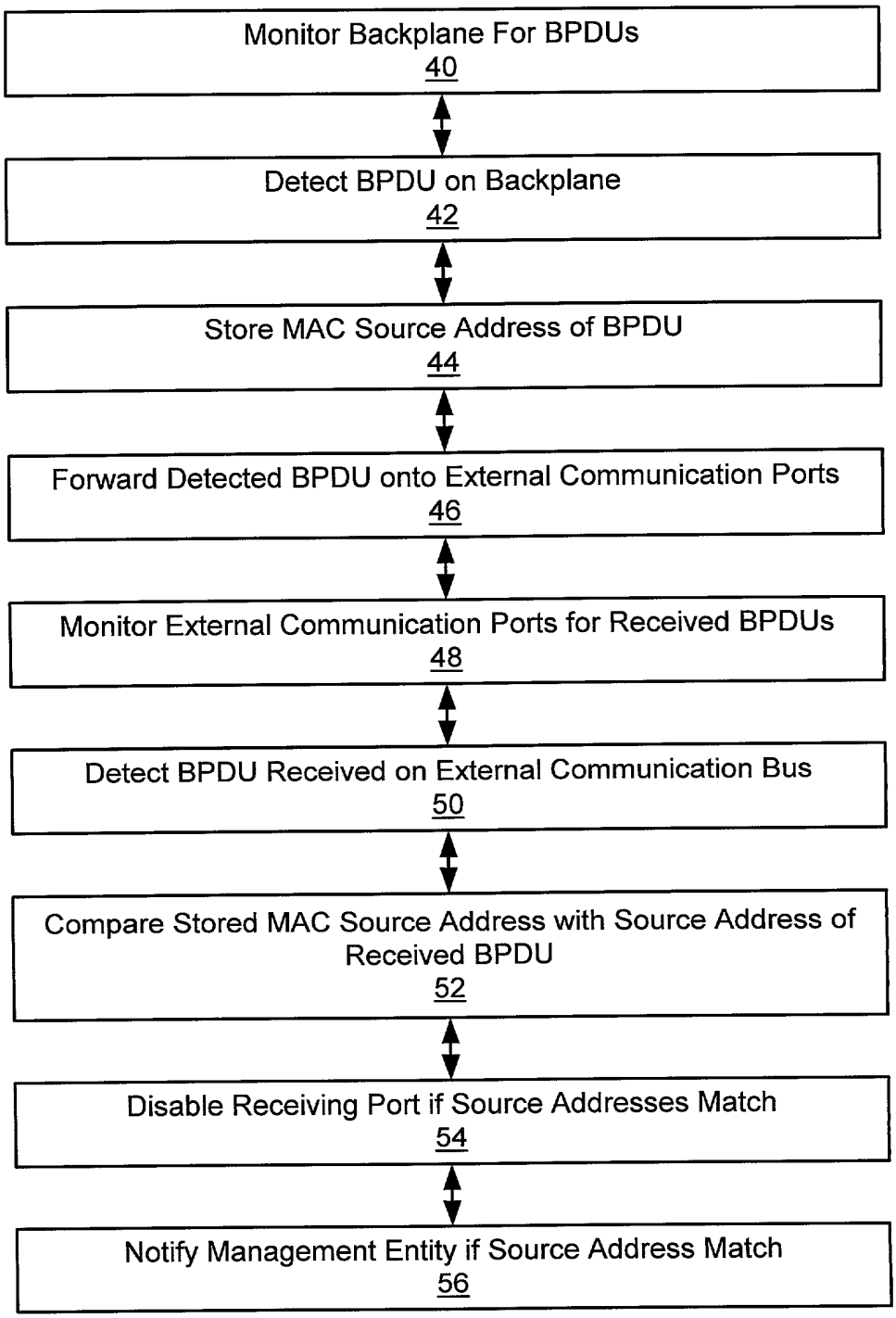
Monitor Backplane For BPDUs
40
Detect BPDU on Backplane
42
Store MAC Source Address of BPDU
44
Forward Detected BPDU onto External Communication Ports
46
Monitor External Communication Ports for Received BPDUs
48
Detect BPDU Received on External Communication Bus
50
Compare Stored MAC Source Address with Source Address of Received BPDU
52
Disable Receiving Port if Source Addresses Match
54
Notify Management Entity if Source Address Match
56

Fig. 2

DECLARATION AND POWER OF ATTORNEY

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **INTELLIGENT NETWORK TOPOLOGY AND CONFIGURATION VERIFICATION USING A METHOD OF LOOP DETECTION**

the specification of which (check one):

[X] is attached hereto. [ ] was filed _____ as Application No._____
amended on _____(if applicable).

[ ] was filed as PCT International Application No. _____ on _____,
and was amended under PCT Article 19 on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations §1.56(a).

I hereby claim foreign priority benefits under Title 35, USC §119(a)-(d) of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)		Date Filed	Priority Claimed	
(Number)	(Country)	(Day/Month/Year)	[ ] Yes	[ ] No
(Number)	(Country)	(Day/Month/Year)	[ ] Yes	[ ] No

I hereby claim the benefit under Title 35, USC §119(e) of any United States provisional application(s) listed below:

(Application Number)	(Filing Date)
(Application Number)	(Filing Date)
(Application Number)	(Filing Date)

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I hereby claim the benefit under Title 35 USC §120 of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35 USC §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application No.)	(Filing Date)	(Patented/pending/abandoned)
(Application No.)	(Filing Date)	(Patented/pending/abandoned)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business connected therewith in the Patent and Trademark Office, and to file with the USRO any International Application based thereon.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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